



# New airline entry rates in deregulated air transport markets

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## Abstract

This paper studies the influencing factors on entry (certification) of new airlines into the US airline industry over 21 years (1979–1999). These rates exhibit considerable fluctuations over the observed period. We analyze the US airline industry for a period of 21 years to determine the relationship of the observed fluctuations in the entry rates with political and extraordinary events, economic conditions and several industry specific variables. We present maximum likelihood estimates of an entry model on the negative Binomial distribution. This methodology reflects the discrete nature of the dependent variable. The results support the notions of positive macro-economic and industry specific developments on the entry opportunities of new airline companies. © 2002 Elsevier Science Ltd. All rights reserved.

**Keywords:** Market entry; Deregulation; Industry ecology; Political signaling

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## 1. Introduction

Research on entry in deregulated air transportation markets has been divided into two main streams. The first group studies the entry of new entrant carriers into new routes and hubs (Hendricks et al., 1997; Windle and Dresner, 1995; Whinston and Collins, 1992; Hurdle et al., 1989), while the other group focuses on survival of post entry carriers (Levine, 1987; Gudmundsson, 1998, 1999). However, relatively little research effort has dealt with entry of new airlines into the industry (see Dresner and Windle (1999)), i.e. what are the determinants of successful certification and start of operations by new airlines. For this kind of research an a priori

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assumption is that entry rate of new carriers is a determining factor of competition intensity and dynamics in the industry. The formation of new airline companies and the process towards an operating fitness certificate issued by the US department of transportation (DOT) is associated with a number of barriers and influences. Such barriers to certification are likely to be financial, equipment availability (aircraft), cost of capital, anticipated competition, government and regulatory policy and extraordinary events.

The purpose of this paper is to investigate the relative importance of economic conditions, political and regulatory environment, and competition on the number of entrants in the US airline industry. Section 2 presents a summary overview of the entry procedure for the airline market in the US. In the following section we will discuss each source of barriers specifically and define the hypotheses. Section 4 describes the data and the variables. Section 5 discusses the study methodology including model and estimation techniques. Section 6 presents the empirical results and Section 7 contains the conclusions.

## 2. US airline market

A new airline applying for operating certificate from the DOT must prove financial fitness. From 1990 through July 1995 the DOT filed 180 applications for all operating categories (jet and prop) of which 50% completed the process successfully. Of these 90, 57 were operating in July 1995, while 33 began operations but folded operations within the period. Furthermore, 33 applicants were found fit but never commenced operations, while 47 did not complete the process, were dismissed or denied certificate. For proposed jet operations the numbers are different as 41 carriers were found fit in the period January 1990 to December 1995, and of these 41, 30 commenced operations (GAO, 1996). Looking at the period 1979–1999 for jet operating carriers (see Table 1), we see that 176 received operating certificate, 123 (70%) started operations and 37 (21%) certificates are still in effect.<sup>2</sup>

### 2.1. Certification process

New airlines need two separate authorizations from the DOT before commencing operations. One is the *economic authority* from the Office of the Secretary of Transportation (OST) and the other is the *safety authority* for the Federal Aviation Administration (FAA). The OST is concerned with the applicant's management competence, ability to comply with regulation and financial resources to operate the airline. The FAA flight standards service (FSS) determines whether the applicant's personnel, facilities, aircraft and manuals meet federal safety standards.

The process is dual as demonstrated in Fig. 1, meaning that an applicant can meet one agency requirement but fail in another process.

GAO (1996) reported that the primary cause of applicants, found fit in the OST process, but failing to begin operations was lack of financial resources. Yet the OST had found these appli-

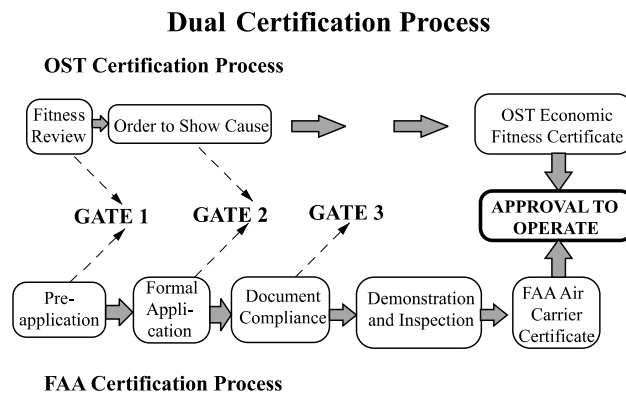
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<sup>2</sup> This number includes charter and cargo operators.

Table 1  
Entry Statistics in the US airlines industry 1979–1999

Year	Total jet fitness certificate issued	Commenced operations	Proportion commencing operations	Existing certificates in 1999
1979	18	15	0.83	2
1980	11	6	0.55	1
1981	19	13	0.68	4
1982	16	10	0.63	1
1983	17	12	0.71	4
1984	23	17	0.74	3
1985	8	4	0.50	0
1986	5	3	0.60	0
1987	3	3	1.0	1
1988	2	2	1.0	2
1989	7	6	0.86	2
1990	1	1	1.0	0
1991	2	2	1.0	1
1992	7	6	0.86	2
1993	8	6	0.75	5
1994	12	8	0.67	4
1995	3	3	1.0	0
1996	6	3	0.50	2
1997	4	1	0.25	1
1998	1	1	1.0	1
1999	3	1	0.33	1
Total	176	123	0.70	37

Source: DOT, 2000. Note that the issuance of a fitness certificate can involve existing carriers changing operating status. The status of few airlines 1997, 1998 and 1999 was uncertain at the issuance of the data in 2000, there may be some discrepancies for these three years.



Source: FAA 90 Day Safety Review, 1996.

Fig. 1. New airline certification process.

cants financially fit before they had sufficient funds to complete both certification processes (GAO, 1996, p. 6). Thus, the FAA and DOT have tried to harmonize the process so that

applicants must complete certain steps, called gates, in both processes before being allowed to continue the certification process. After the FAA certification process is successfully completed the OST requires the applicant to verify that sufficient funds have been raised for beginning and sustaining operations. One of the reasons for this approach is that most applicants are unable to raise capital unless the OST has found them financially fit, as financial institutions will require such assurance. Yet the approval of the OST is no guarantee that sufficient funds will become available. The FAA as reported by GAO will as a consequence spend internal funds to process the application and in many cases find the applicant fit, although the applicant will eventually not meet the OST financial criteria. As a consequence the OST raised the standards by requiring third-party verification and copies of funding instruments before the applicant is found fit.

### 3. Barriers to certification and hypotheses

#### 3.1. *Financial and equipment barriers to certification*

In our analysis we segregate financial barriers into two categories labor costs and access to capital, represented as cost of capital. The equipment barrier deals with the level of aircraft availability. Most new airlines keep entry costs at minimum by utilizing efficiently the retired aircrafts from the larger airline companies.<sup>3</sup> Dresner and Windle (1999) examined the influence of two factors on nonincumbent entry rates on individual routes. The factors were labor costs and aircraft availability. Labor costs are assumed to be related to the supply of labor and the same applies to aircraft, the higher the supply the lower the acquisition cost or lease rates.<sup>4</sup> The greater the emphasis on cost savings in the industry, associated with industry down cycles, the more likely it is that new entrants have access to cheap but proficient labor. In addition, during such period it is also likely that existing airlines retire aircraft equipment due to consolidation in the route network and inefficiencies of older aircraft. Yet, these production factors did not show a clear relationship<sup>5</sup> with entry rates as expected in a study by Dresner and Windle.<sup>6</sup> Based on their results we decided in our research not to include these two factors but explore other potential factors. We selected interest rates to represent cost of capital as a proxy for financial barrier to entry. High capital requirements can discourage potential entrants. In particular, when the potential entrants have to borrow loans at a high interest rate. Thus,

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<sup>3</sup> Most common aircraft types used in the past have been Boeing 737, 727 and Douglas DC9.

<sup>4</sup> The majority of new airlines lease aircraft rather than buy, because of inability to fund acquisition, conservation of capital, reduce financial risk, increase flexibility and facilitate upgrading of aircraft later.

<sup>5</sup> One of the reasons why a large increase in the supply of used aircraft does not necessarily lead to indiscriminately better access is that leasing companies need to be assured that the lessee is capable of keeping up the payments as the lessor still has to pay to the financiers (usually banks) if the lessee fails to maintain payments. Furthermore, the costs of repossessing the aircraft can be substantial on top of lost lease payments, accrued maintenance expense and depreciation expenses.

<sup>6</sup> They reported a slight correlation, but insufficient to demonstrate a clear relationship.

**Hypothesis 1.** A decrease in interest rate will have a positive impact on entry of new carriers.

Another important barrier is the share of investment that must be committed by the entrant. Commitment costs enhance the entrant's vulnerability to retaliatory responses by the incumbents. These costs diminish the rate at which entry responds to positive incumbent profits (Caves and Porter, 1977). However, the share of long-run outlays in total costs is likely to be low in those industries that are using capital that can be easily leased or for which an active second-hand market exists (Kessides, 1990). A high proportion of commitment investment in the entry costs impedes the establishment of new airlines. Thus, it is expected that there exists an inverse relationship between the aircraft equipment barrier and the entry rates of new airlines. This leads to the following hypothesis:

**Hypothesis 2.** A decrease in aircraft cost as percentage of total expenditure will have a positive impact on entry of new carriers.

### 3.2. Demand

Several studies suggest that industries enjoying favorable economic conditions—such as demand growth—are, in general, more attractive to potential entrants (see, e.g. Geroski (1995) and Baldwin (1998)). It is expected that the ability of the airline industry to remain attractive for potential entrants is dependent on the growth of the economy. Since the huge initial investments are undertaken on the basis of a given market size, which at that point in time is considered as sufficiently attractive for new airline companies to enter the industry. The higher the rate of growth of the economy, *ceteris paribus*, the less an entrant's action will depress the industry profit. The rate of growth of gross domestic product (GDP) may be a useful measure of the incentive to enter. This leads to the following hypothesis:

**Hypothesis 3.** The probability that a new airline company will enter is positively related to economic growth in the country.

### 3.3. Political and regulatory environment and extraordinary events

Since deregulation of the US air transportation industry in 1978 we can state that a discontinuous change occurred in the political environment of airlines. Yet, the impact of political environments on organization populations has not been researched to any large degree. Carroll et al. (1988) demonstrated that under regulation organizations are often accountable to fewer regulatory agencies, while deregulation has a decentralization effect rather than a reduction in regulation *per se*. The argument is highly appropriate although one must assume that deregulation is concerned with the economic aspects and thus truly a reduction of constraints within that specific area of running airlines. However, deregulation has demonstrated that regulation dealing with safety and competition enhancing aspects of the operating environment, such as, anti-trust, access and entry, have taken on a greater role.

The start of deregulation was an important political event marked by the pro-consumer Carter Administration. The second important event was the transfer of power to the Reagan

Administration, which was characterized by laissez faire policy. The Bush Administration continued the policy in regard to the airlines.

Governments enter office with various pledges to voters and are expected to funnel their policy throughout the various agencies that influence these pledges, thus, constituting an agency problem. If there is a narrow gap between the politicians and the agency the efficiency of the representation is enhanced in terms of realizing political pledges to the constituents (see Campbell and Lopez (1998)). We define this activity as political signaling or in other words the attempt to influence agencies to adopt certain political directions in internal policy. It is important to note that due to an agency problem such influence may be subtle rather than direct. Thus, signaling can be in the form of who is nominated to head a specific agency, investigations undertaken, speeches and news articles both external and internal to the agency. We assume that strong political signaling will facilitate agency actions in accordance with the principal's intentions, given that these do not violate underlying principles of the agency's operation, such as ethics and safety. Assuming that governments act in a rational way, signaling will be strong if the issue at hand is considered to influence voters positively, but agency signaling will neutralize if an extraordinary event impacts the issue in a negative way, i.e. if voting signal is altered due to a change in public opinion.

In 1993 the Clinton Administration came into power with a strong pro-entry policy (Moorman, 1993) and nominated a strong advocate of that policy to the position of Transportation Secretary. This government sent strong political signals that consumers should benefit from low-cost air travel (DOT, 1996) and therefore low-cost entry should be stimulated in air transportation markets. However, in late 1995 and mid 1996 there were two events that had impact on the US airline industry. The first event was the change in the DOT fitness procedures, marked by more stringent measures to prove financial fitness as already discussed. The apparent drive for these changes was efficiency, i.e. expenditure per application was considered high in view of many applicants entering the latter parts of the procedure, but then being unable to find the necessary financial resources to start operations (GAO, 1996). Shortly after the change in the fitness procedures, the second extraordinary event occurred when ValuJet, a low-cost new-entry success story, had a tragic plane crash in Florida. The immediate assumption in the media was that low-cost new entrant airlines were cutting corners on safety to keep costs down. A relatively homogenous coverage along these lines caused the Federal Government to distance itself from agency signaling concerning the benefits of low-cost new-entry due to strong public signaling marked by the avoidance of such carriers. The agency signal was neutralized marked by the resignation of the incumbent Transportation Secretary an advocate of the policy. Thus, we hypothesize that the scrutiny of operating fitness applications by the agent was increased in the name of public good, i.e. public safety (see GAO (1996)). Also, one must assume that applicants for a fitness certificate faced a raised barrier to new airline capitalization. Given these events in the airline industry we define two related hypotheses with respect to entry of new airlines.

**Hypothesis 4a.** Favorable political climate ratified through pro-entry political signaling will have a positive impact on the number of operating fitness certificates issued (by DOT).

**Hypothesis 4b.** Although a change in the certification process and an extraordinary event such as the accident will have a negative impact on the number of operating fitness certificates issued, the favorable conditions in the airline industry still dominate this event and change (by DOT).

### 3.4. Competition

A common a priori assumption is that a rational entrant will base his decision to enter an industry on anticipated post-entry profits. Supporting that notion, Hannan and Carroll (1992) found that the entry level is inversely proportional to the level of competition in an industry.<sup>7</sup> Therefore, their findings support the assumption that the expected competitors' reactions to entry influence the choice of potential entrants whether or not to enter a market. Incumbent firms may follow a strategy of predatory pricing, setting the price at such a (low) level that new entrants' profit opportunities reduce to zero. However, predation does not necessarily have to occur in highly competitive markets if threat by reputation or other reaction signals exists. Southwest Airlines, for example, has kept to its policy of avoiding incumbents' strong holds throughout its history, even after it entered the ranks of a major carrier, thus not testing the incumbents' ability to exercise competitive force, whether predatory or not. Yet, the underlying economic theory of deregulation 'contestability' has been found not to apply in air transportation markets (Levine, 1987; Whinston and Collins, 1992).

The intensity of competition is likely to be influenced by the anticipated response of incumbents on entry. Incumbent firms can use strategic and tactical actions to deter entry or to protect their market share (see, e.g. Bain (1956), Sutton (1991) and Thomas (1999)). One of the more important determinants of competition is advertising. Advertising matters to airlines because it is a way of attracting customers and to deter potential entrants in a particular niche (Beven, 1974; Schmalensee, 1978; Yip, 1982). Levine (1987)<sup>8</sup> also suggested that the higher the entry rate the stronger the reaction by incumbents through advertising expenditure. Thus, the incumbent firms use advertising as a way to build consumer loyalty in order to deter entry (e.g. Bunch and Smiley (1992)). However, the role of advertising has been a subject of ongoing controversy in the industrial organization literature. Another group points out that advertising increases the size of the market and does not result in market share losses. In other words, more advertisements and promotion in the airline industry stimulate potential airline companies to enter the market. Consequently, advertising as information perspective makes the markets more competitive and drives down profit rates eventually (e.g. Roberts and Samuelson (1988), Greuer et al., 2000 and Scott Morton, 2000).

In this study, we assume that competition intensity is working as a deterrent to entry. We hypothesize that the higher the proportional expenditure on advertisements and promotion from one year to another, the more intense the competition environment is, and the lower the entry rate (e.g. Bain (1956), Orr (1974), Deutsch (1984) and Baldwin, 1998). Thus,

**Hypothesis 5.** Competition intensity (measured through proportional advertising expenditure) will negatively affect the number of new airlines in the air transportation industry.

<sup>7</sup> They also show an inverse relationship with entry rates and industry concentration.

<sup>8</sup> See pages 425–432. (See also: Airline Advertising Reform Act of 1991 (H.R. 5124), House of Representatives, 102 Congress, 2nd Session. September 24, 1992. US Government Printing Office, Washington, 1993.)

#### 4. The data

In order to test the hypotheses that we have developed so far, we constructed a data set on the US airline industry composed of data from various sources. The primary sources we employ were from the DOT, Air Transport Association and US Census Bureau. The first source provided information regarding the number of entrants, while the second one provided data about airline cost factors. The Statistical Abstract indicators database of the United States of the US Census Bureau provided an extensive collection of data about social, economic and political indicators. For the information on political and regulatory environment and extraordinary events we also consulted newspapers and specialized journals which reported on the events.

The dependent variable in our research is the annual total number of jet fitness certificates issued in the US. For this study we also apply a number of explanatory variables that could influence the number of certificates issued. The cost of capital has a direct impact on production, competition and the structure of the market. In general, high capital requirements can discourage potential entrants. The first variable is related to the cost of borrowing a loan. We include the average book interest rate in percentage, *interest rate*, as an indicator of capital barrier. To estimate the relationship of the equipment barrier to entry of new airlines, we used average aircraft costs<sup>9</sup> as percentage of total expenditure (major and national airlines), *aircraft costs*. This variable reflects the proportional cost of leasing and/or purchasing costs of aircraft in use by US airlines.

Rapid growth in demand creates opportunities for firms to enter irrespective of the size of the entry barrier. In previous studies it is shown that a growing economy will stimulate the demand of the number of flights. This development creates opportunities for potential airline companies to enter the market. Hence, we argue that entry should be positively related to the demand growth. The relative change in the real US GDP, *growth GDP*, is used as a measure of the industry demand growth.

A measure of average annual advertising and promotion expenditure per ton-miles by the incumbents in dollar cents, *advertising costs*, is used as a proxy to represent competition intensity in our study. We examined the relationship between Herfindahl–Hirshman Index<sup>10</sup> (HHI) a well known measurement for industry concentration and the proportional advertising expenditure. We found a negative correlation (–0.21), indicating that as airline industry concentration goes down advertising expenditure goes up. The advertising and promotion costs are converted in a log variable, because we are interested in the relationship between the entry of new airlines and the advertisement and promotion costs in percentage.

Government policy and extraordinary events for the US airline industry are indicated by two dummy variables in our model. The involved events are deregulation by the Carter administration, the laissez faire policy of the Reagan administration, the Clinton's pro-entry policy, the FAA revision of certification process and the ValuJet crash. It is likely that the last two events had a negative impact on the number of entrants, while the others stimulated entry. To control for these different impacts, two dummy variables, *extraordinary* and *political events*, are included which

<sup>9</sup> Includes lease, aircraft and engine rentals, depreciation and amortization (passenger airlines only).

<sup>10</sup> HHI < 1001 = low, 1001–1800 = medium, >1800 = high concentration.



take the value of one if one of these events occurred in the previous year. The dummy variables measure the direct effect of an event on the number of new airlines in the following year. Since we are interested in the indicative impact of an event we believe that such impact is captured in the model effectively through change in entry in the year following an event.

#### 4.1. Descriptive statistics

Table 1 shows the DOT certification statistics for jet operating airlines from 1979 to 1999. The data demonstrates two peaks of fitness certificates issued after a rather even period from 1979 (18), peaking in 1984 (23) and a second shorter period from 1992 (7), peaking in 1994 (12). New jet operating airlines actually commencing operations was used in our analysis to capture any barriers that might affect the applicants in the process, including any barrier internal to the process itself such as stricter requirements or external to the process such as capital access. New airlines actually commencing operations show similar trends as in DOT certificates issued, with a peak in 1984 (17) and a second peak in 1994 (8). Of the total number of new airlines commencing operations from 1979 to 1999 only 30% had operating certificates in effect in 1999.

Descriptive statistics of the variables are presented in Table 2 and explanatory variable correlations in Table 3. The mean of number of certificates issued in the US airline industry was 5.8 but the standard deviation is high (5.0), with values ranging from 1 to 17 (for 1984). Five historical events (24% of the sample time-series) were classified as influential governmental actions and extraordinary events on the dynamics of the US airline industry. Mean interest rate for the period 1978–1998 is 9.3. This reported mean is high because the minimum interest in the investigation period was 7.1%. The average annual interest rate was above 10% at the beginning of the eighties. The ratio of aircraft costs relative to total expenditure of an airline was, on average 7.6%. The growth of the GDP in the United States was on average 3.0%, but the standard deviation is relatively high (2%), with growth rate values fluctuating between a decline of 2% and an increase of 7%. The reported mean of the advertising and promotion costs per revenue ton-miles was, on average, 2.0 dollar cents. The development of this particular component of costs for US airlines shows an u-shaped curve.

Table 2  
Descriptive statistics (21 year)

Variable	Description	Mean	S.D.	Min.	Max.
Entry	Total no. jet carriers fit and operating	5.8	5.0	1	17
Political events (+)	Pro-entry events	0.14	0.36	0	1
Extraordinary events (–)	Negative events	0.01	0.30	0	1
Interest rate	Average annual book interest rate in percentage	9.3	1.1	7.1	11.2
Aircraft costs	Aircraft costs as percentage of total expenditure	7.6	1.6	5.2	9.7
Growth GDP	Annual growth rate of GDP	0.03	0.02	–0.02	0.07
Advertising costs	Advertising and promotion costs per revenue ton-miles in cents	2.0	0.5	1.2	2.5

Table 3

Variable correlations (Pearson) of explanatory variables

<i>N</i> = 21	Political events	Extraordinary events	Interest rate	Aircraft cost	Growth GDP	Advertising cost
Political events (+)	1.000					
Extraordinary events (–)	–0.132	1.000				
Interest rate	–0.131	0.039	1.000			
Aircraft costs	–0.181	0.439*	–0.404	1.000		
Growth GDP	–0.232	0.162	–0.090	0.260	1.000	
Advertising costs	–0.238	–0.349	0.768***	–0.276	0.026	1.000

\* Correlation is significant at the 10% level (two-tailed).

\*\*\* Correlation is significant at the 1% level (two-tailed).

## 5. Methods and specification of analysis

### 5.1. The method

Since the aim of this research is to investigate the relative importance of various determinants of entry rate in the US airline industry, it is appropriate to use a longitudinal research design. The particular design chosen was a study from 1978 until 1999. The number of entrants in this study is defined as the total number of entry fitness certificates issued in a given year that lead to actual entry.<sup>11</sup> Because the number of new airline entrants data are count data (nonnegative integer valued random-data) and deviate from classical regression assumptions, the statistical specification of entry calls for a discrete-probability distribution. In order to meet this requirement, an econometric model of number of entrants is used that is based on both the Poisson and negative Binomial distributions. This methodology is in the spirit of Hausman et al. (1984), Cameron and Trivedi (1986) and Davutyan (1989), who apply the discrete-probability models to count data on patent applications across firms, consumer demand for health care services, and bank failures respectively.

The discrete probability approach admits a richer analysis of the number of entrants than the classical regression models based on the principle of ordinary least squares method of model estimation. First, the classical linear (OLS) models can provide an incomplete description of the entry data. The logarithm transformation of entry is only well defined for positive entry rates, and undefined when entry is absent. Second, a discrete variable with strictly nonnegative values cannot be normally distributed. These problems are overcome by the Poisson approach. With the distribution of the number of entrants specified as Poisson, we are able to estimate the probability of the entry rate and the relationship with the intentions of the US government, and other industry and macro-economic developments.

<sup>11</sup> A proportion of airlines receiving OST and FAA operating certificate are unable to demonstrate capital in accordance with financial plan and do therefore not commence operations.

The number of new airline entrants data are assumed to be generated by the following Poisson distribution:

$$\Pr(E_i) = (\exp(-\lambda_i)\lambda_i^{E_i})/E_i \quad (1)$$

The mean and the variance of  $E_i$ , the number of entrants, are equal to  $\lambda_i$  with specification  $\lambda_i = E[E_i|X_i] = g(X_i, \beta) = \exp(X_i\beta)$ . Hence, the explanatory variables,  $X_i$  enter the model by specifying the Poisson parameter  $\lambda_i$  as a function of  $X_i$  and an unknown parameter,  $\beta$ , to be estimated.

However, many entry data have a variance exceeding the means and are thus overdispersed relative to the Poisson rate. The negative Binomial model provides a mechanism for incorporating overdispersion in the count model (Grouieroux et al., 1984a, 1984b; Hausman et al., 1984 and Cameron and Trivedi, 1986). This generalized model encompasses the Poisson distribution and allows the variance of the process to differ from the mean. The Poisson model makes no allowance for an error term, while the negative Binomial model allows for the incorporation of an additional parameter, the dispersion parameter, which can act as an error term. This means that if one or more important explanatory variable is not included, the dispersion parameter provides a mechanism for incorporating unobserved variables into the analysis (Greene, 1997).

The validity of the variance–mean equation can be tested with the classical standard methods such as the likelihood ratio test and the Wald test. More optimal tests are the regression based ones that test the assumption of variance–mean equality,  $\text{VAR}(E_i) = \text{Mean}(E_i)$  as a null hypothesis, against alternative hypothesis  $H_1: \text{VAR}(E_i) = \text{Mean}(E_i) + \alpha(\text{Mean}(E_i))^2$ . If  $\alpha = 0$ , then the mean–variance equality for the number of entrants data set cannot be rejected. Our statistical benchmark model for the number of new airline entries in the US airline industry is thus the Poisson model. We compare the estimates of both count data models to show the extent to which the effects of the explanatory variables on the number of new airline entries are robust and whether the effect of changes in specifications of the model makes a difference.

## 6. Empirical results

The results of the Poisson and the negative Binomial models explaining the number of issued new airlines certificates are presented in Table 4. The leftmost model reports the results of a Poisson analysis and the right model reports the results of a negative Binomial analysis of the same data. Two likelihood ratio statistics are presented. The first Chi-squared value shows the significant improvement of the Poisson model with explanatory variables upon the Poisson model with a constant term only. In order to choose between the Poisson and negative Binomial model, we tested the mean–variance equality hypothesis. Table 5 shows the result of the regression-based test for overdispersion of Poisson model. The test shows no clear evidence of overdispersion in the data, since  $\alpha$  is insignificantly different from zero in the regression-based test. This is also confirmed by the additional overdispersion parameter in the negative Binomial model to allow for overdispersion beyond the effects of explanatory variables. The corresponding Chi-squared value (0.50) differs insignificantly from zero.

As hypothesized, the coefficient of political events has the expected positive sign and is statistically significant. The pro-entry political signaling events are significant, at  $p$  0.00 and  $p$  0.026

Table 4

Results of the Poisson and negative Binomial models explaining the number of issued new airlines certificates

Variable	Poisson model	Negative Binomial model
Political events (+)	0.95*** (0.26)	0.95** (0.43)
Extraordinary events (–)	0.66 (0.82)	0.66 (0.96)
Interest rate	–0.34 (0.28)	–0.34 (0.33)
Aircraft costs	–0.50*** (0.12)	–0.50*** (0.16)
Growth GDP	15.21*** (4.38)	15.21** (7.76)
Advertising costs <sup>a</sup>	1.40 (1.20)	1.40 (1.24)
Constant	6.87** (2.57)	6.87** (3.30)
Dispersion parameter		0.07 (0.12)
Loglikelihood	–47.92	–47.66
Chi-squared	57.77***	0.50
Df	6	1

Standard errors in parentheses.

\*\* Significant at the 5% level (two-tailed test).

\*\*\* Significant at the 1% level (two-tailed test).

<sup>a</sup> The discrete count models are also estimated without the explanatory variable advertising costs (also in log). The parameter estimates of the other variables and their significance level did not differ from the estimation results given in the table.

Table 5

Test for overdispersion in Poisson model

Coefficient $\alpha$	Standard error	<i>t</i> -ratio
0.02	0.04	0.39

respectively. A pro-entry action in a particular year stimulated the number of entrants in the following year. There is evidence that government changed the opportunity for potential airlines to enter successfully the market through intervention or announcements of potential actions. To assess if there was a negative impact on entry into the industry attributable to the ValuJet crash and the change in the certification process, we included the Extraordinary event period as a separate variable. The *extraordinary* coefficient is not significantly different from zero in both models,  $p$  0.43 and  $p$  0.50 respectively. In other words, the ValuJet crash and the change in the certification process (both happened at approximately the same time) had no significant effect on entry in the following year. These results suggest the overriding effect of long-term favorable conditions over negative events such as accidents, whose impact seem to have short-term impact on voters- and therefore likewise impact on political signaling.

The cost of capital of airlines, measured by the average annual book interest rate (interest rate), has the expected negative effect on the number of entrants, however, it is statistically insignificant from zero. We therefore find no support for hypothesis one. Another indicator that high capital requirements can discourage potential entrants is the explanatory variable aircraft cost. The estimated coefficient is negative and highly significant. This result strongly supports hypothesis two. The impact effect that can be measured based on the coefficient indicates that the effect of an

increase is large. The elasticity of number of entrants with respect to aircraft cost is  $-3.80$  in the model.<sup>12</sup>

Economic growth in the United States was expected to raise the probability of new entry into the US airline industry. The estimated coefficient for this variable is positive as expected and statistically significant. Hence, the growth in GDP as an indicator for increased demand (growth GDP) has a positive effect on the number of entrants. The magnitude of the effect of growth in GDP on number of entrants also is large with an elasticity of 0.46.

Our last hypothesis tested the relationship between advertising and promotion intensity and entry. In our model the variable advertising costs was a proxy for competition intensity based on the assumption that as advertising intensity increases it impedes new carriers to enter the industry. We find no conclusive evidence on the relationship between advertising and promotion expenditure and the number of entrants. We therefore cannot confirm whether fluctuations in advertising and promotion, as proxy for competition intensity, is a post-entry phenomena or an influencing factor on entry into the industry.

## 7. Conclusion

Political events such as a change in policy play a significant role in entry rates of new airlines into the industry. However, our study showed a nonsignificant relationship between extraordinary events and entry rates.

Our findings show a highly significant relationship between aircraft cost and entry rates. This variable for acquisition costs [lease, depreciation and amortization] of aircraft for new entrants is important in view of unclear relationship reported in previous research between availability of used aircraft in the market and entry rates. Thus, supporting the notion that if this kind of cost of capital is favorable, it will have positive impact on entry.

Favorable economic conditions in the US such as demand growth attract potential airlines to enter the industry, because the entrant's action not significantly depresses the incumbents and industry profit. Our study demonstrated a highly significant relationship between growth GDP and entry.

Advertising cost as a proxy for competition intensity did not demonstrate synchronization with entry rates. This finding did not provide new insights on the impact of advertisements and promotions on the entry rates of an industry.

We have shown that even in deregulated markets political events can play a role in entry rates to an industry. Yet it is not clear that a change in voting signals or popular opinion, whether rational or not, can cause a swift change in a political signal. In our study it is not shown if this kind of change had any marked impact on the entry rate. Furthermore, we identified that changes in internal agency processes towards certification probably have impact on the number of airlines completing the process successfully. Although this relationship could not be fully tested in our

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<sup>12</sup> Calculated in the conditional mean (predicted value of entry with all explanatory variables taken in the sample mean) of  $-3.80$ . It should be noted that the skewed distribution of number of new issued entry certificates in the sample results in a conditional mean below the sample mean of 5.8. The calculated elasticities are likely to differ if evaluated at other sample points.

research, we defined two negative events close in time, including the ValuJet crash, as a separate variable and did not find significant impact on entry rates.

However, it should be clear that due to the greatly reduced entry rates agency policy should be to keep internal certification barriers to a minimum by facilitating a process that is convenient to the applicants, without jeopardizing public interest or safety. For further research, it is therefore recommended to investigate whether entry in deregulated markets has impact on market structure, benefiting consumers to a much greater extent than the cost to the agency of processing applications for operating certificates.

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